Electric Motor with Electromagnetic Brake

Prior Art

The invention proceeds from an electric motor with an electromagnetic brake means as claimed in the preamble of claim 1. An electric motor with an electromagnetic brake is known (GB 920,485) which has a stator with two poles which each have a pole shoe which projects to the inside and which is surrounded by a stator winding. The brake means comprises a brake element for braking of the rotor of the electric motor which is located symmetrically within one pole at a time and which is subjected to a braking force in the middle. The brake element can be adjusted against the braking force by the magnetic field of the stator winding. The defect is that the arrangement of the brake element within the pole does not allow high disengagement forces so that the brake element can only be exposed to a relatively small braking force. The maximum attainable braking action of the brake means is therefore only low so that the brake means is not suitable for use for example in angle grinders.

Advantages of the invention

The electric motor as claimed in the invention with an electromagnetic brake means has the advantage of ensuring high disengagement force so that a high braking force can be achieved with the correspondingly good braking action. By making the brake element as a rocker on which the braking force acts outside its swivelling axis, the level of the disengagement force can be greatly increased. The brake means is thus much more efficient and is also suited for use in angle grinders.

The measures enumerated in the dependent claims enable advantageous developments and improvements of the electric motor as claimed in the invention.

Drawings

An embodiment of the invention is shown in the drawings and is detailed in the following description.

Figure 1 shows a partial section through an electric motor as claimed in the invention,

Figure 2 shows a section through a stator half without a brake element which can be

inserted therein, and

Figure 3 shows a top view of a stator pack of the electric motor.

Description of the embodiment

In Figure 1 the electric motor, labelled 10, has a stator 11 and a rotor 12. The stator 11, of which only the upper half is shown, forms a pole pair, of which one pole is labelled 14. The pole 14 has a pole shoe 15 which is pointed from the yoke 13 to the inside to the rotor periphery, and which emerges on both sides in pole horns 16, 17. Between the pole horns 16, 17 and the yoke 13 recesses 18, 19 are formed into which a stator winding 20 fits. The stator winding 20 thus surrounds the pole shoe 15.

In the stator 11 in the area of the pole shoe 15 a radially continuous free space 21 is formed into which a brake element 23 of a brake means 22 is inserted. The brake element 23 fills the inner part of the pole shoe 15 between the pole horns 16, 17. The brake element 23 forms lateral separating surfaces 24, 25 which pass radially relative to the stator 11 and the pole face 26 facing the rotor 12. The brake element 23 is made of magnetically conductive material so that passage of the magnetic flux induced by the stator winding 20 in the stator 11 and in the brake element 23 takes place in the separating surfaces 24, 25 and in the pole face 26.

The brake element 23 is made as a rocker which has one laterally projecting pin 27 each on the sides facing away from one another. The pins 27 form a swivelling axis 28 around which the brake element 23 is pivotally supported within limits relative to the stator 11. The brake element 23 is made as a multi-arm lever with lever arms 29, 30 which are located on either side of the swivelling axis 28. The lever arms 29, 30 are roughly at an angle of 180 degrees to one another, the brake element 23 being matched roughly to the ring structure of the yoke 13. The first of the lever arms 29, 30 forms a brake arm 29 which on the inside facing the rotor 12 bears a brake lining 31. The brake lining 31 is produced preferably from a material with little or no magnetic conductivity. The second of the lever arms 29, 30 is made as a disengagement arm 30 and in the area of the pole face 26 forms a narrow annular gap 32 with the rotor 12 which corresponds to the conventional motor air gap.

A compression spring 34 applies a braking force 33 to the brake arm 29 in the direction to the rotor 12. The brake element 23 is thus exposed to the braking force 33 outside of the swivelling axis 28, i.e. off-center, by which the braking moment around the swivelling

axis 28 is produced. The swivelling axis 28 is thus parallel to the axis 39 of rotation of the rotor 12. The brake arm 29 has a plurality of blind holes 44 which are used to hold one compression spring 34 at a time. The compression springs 34 are on the other hand supported on a steady 45' which is attached to the stator 11.

The brake arm 29 is located in front of the swivelling axis 28 viewed in the direction of rotation of the rotor 12, labelled with an arrow 40, conversely the disengagement arm 30 is located behind the swivelling axis 28. In this way the braking action can be additionally increased by boosting the force by a force couple, which consists of friction force and bearing reaction force, forming a torque around the swivelling axis 28 in the direction of the braking force 33.

When the electric motor 10 is turned on, i.e. current flows through the stator winding 20, in the stator 11 a magnetic flux is induced which produces an attraction force on the brake element 23 in the separating surface 25 towards the stator 11 and in the pole face 26 towards the rotor 12. This attraction force causes a quantitatively higher disengagement moment which is pointed opposite the braking moment and which causes a disengagement motion of the brake element 23 opposite the braking moment. In the separating surfaces 24, 25 there is sufficient play of motion for this purpose, which allows the braking element 23 to execute limited swiveling motion around the swivelling axis 28 relative to the stator 11, the brake lining 31 then being lifted by the rotor 12. The separating surface 25 on the disengagement arm 30 has a greater radial distance from the swivelling axis 28 than the separating surface 24 on the brake arm 29 so that the attraction force acting in the separating surface 24 makes an especially high contribution to the disengagement moment. Since the braking arm 29 in the area of the pole face 26 has a greater distance from the rotor 12 than the disengagement arm 30 and since the braking arm 29 bears a non-magnetic brake lining 31 there, there are no noteworthy attraction forces at this point, in contrast to the disengagement arm 30.

In order to prevent frequency-induced vibration of the brake means 22 when current flows through the stator winding 20, in the disengagement arm 30 there is a short-circuited turn 46 in the immediate vicinity to the separating surface 25.

When the electric motor 10 is turned off again, the magnetic action of the stator winding 20 abates so that the attraction force on the disengagement arm 30 likewise abates in the separating plane 25 and in the pole face 26. The braking moment then predominates again so that the brake arm 29 is pressed by the compression spring 34 against the rotor 12;

this leads to braking of the rotor 12. The brake means 22 therefore triggers automatically with the shutoff of the electric motor 10 so that for example in an angle grinder the coasting of the cutting-off wheel is automatically stopped a short time after the motor is turned off.

The stator 11, which is shown only in half-side in Figure 1 in the lower half of the figure which is not shown, has another pole which may or may not be provided with a brake which corresponds to the brake means 22. By providing another brake in a second pole the braking action can be further increased. In any case there the stator 11 is closed roughly in a ring-shape.

In Figure 2 the top half of the stator 11 from Figure 1 is shown without the brake element 23 which is to be inserted therein. It is apparent that the free space 21 is made axially not continuous, but is axially bounded by one segment 37, 38 at a time with continuous stator material. The free space 21 is thus made window-like; this is shown in Figure 3. The segments 37, 38 are each provided with semicircular recesses 35, 36 which are used as supports for the pins 21. In this way the swivelling axis 28 is formed.

The invention is not limited to the embodiment shown. Thus the brake means as claimed in the invention can also be used for more than two-pole electric motors. The braking force can also directly engage the brake lining or the component which bears it, the brake element then being used as a disengagement rocker which is coupled to the brake lining or the component which bears it. The compression springs can also be formed by one or more leaf spring sheets which are attached in the pole shoe 15 or to the stator 11 and produce the necessary braking force.